What is claimed is:

1. A method of making cast shapes of a metallic alloy, comprising the steps of:

melting the alloy to form a melt under vacuum or partial pressure of inert gas;

pouring the melt of the alloy into a cavity of a composite mold comprising a substrate of isotropic graphite having a mold cavity, wherein the surface of the mold cavity is coated with a coating of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC having a thickness from 2 to 500 microns; and

solidifying the melted alloy into a solid body taking the shape of the mold cavity.

2. The method of Claim 1, wherein the cavity is a machined cavity and the coating of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC is deposited on the surface of the machined cavity via either chemical vapor deposition or plasma assisted chemical vapor deposition, or sputtering.

3. The method of Claim 1, wherein the thickness of the coating of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC on the surface of the cavity of the mold is from 2 to 200 microns.

4. The method of Claim 1, wherein the thickness of the coating of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC on the surface of the cavity of the mold is from 7 to 100 microns.

5. The method of Claim 1, wherein the thickness of the coating of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC on the surface of the cavity of the mold is from 10 to 25 microns.

6. The method of Claim 1, wherein the mold is at a temperature between 100 and 800°C just prior to pouring the melt into the mold.

7. The method of Claim 1, wherein the mold is at a temperature between 150 and 800°C just prior to pouring the melt into the mold.

8. The method of Claim 1, wherein the mold is at a temperature between 200 and 800°C just prior to pouring the melt into the mold.

9. The method of Claim 1, wherein the mold is at a temperature between 150 and 450°C just prior to pouring the melt into the mold.

10. The method of Claim 1, wherein the mold is at a temperature between 250 and 450°C just prior to pouring the melt into the mold.

11. The method of Claim 1, wherein the metallic alloy is selected from the group

consisting of a nickel base superalloy, nickel-iron base superalloy and cobalt base superalloy.

12. The method of Claim 1, wherein the metallic alloy is a nickel base superalloy containing 10-20 % Cr, at most about 8% total of at least one element selected from the group consisting of Al and Ti, 0.1-12% total of at least one element selected from the group consisting of B, C and Zr, 0.1-12% total of at least one alloying element selected from the group consisting of Mo, Nb, W, Ta, Co, Re, Hf, and Fe, and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

13 The method of Claim 1, wherein the metallic alloy is a cobalt base superalloy containing 10-30 % Cr, 5-25% Ni and 2-15 % W and 0.1-12% total of at least one other element selected from the group consisting of Al, Ti, Nb, Mo, Fe, C, Hf, Ta, and Zr, and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

14. The method of Claim 1, wherein the metallic alloy is a nickel-iron base superalloy containing 25-45% Ni, 37-64% Fe, 10-15 % Cr, 0.5-3% total of at least one element selected from the group consisting of Al and Ti, 0.1-12% total of at least one element selected from the group consisting of B, C, Mo, Nb, and W, and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

15. The method of Claim 1, wherein the metallic alloy is a stainless steel alloy based on Fe, containing 10-30 % Cr and 5-25 % Ni, and 0.1-12% total of at least one element selected from the group consisting of Mo, Ta, W, Ti, Al, Hf, Zr, Re, C, B and V, and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

16. The method of Claim 1, wherein the metallic alloy is based on titanium and contains at least about 50% Ti and at least one other element selected from the group consisting of Al, V, Cr, Mo, Sn, Si, Zr, Cu, C, B, Fe and Mo, and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

17. The method of Claim 1, wherein the metallic alloy is titanium aluminide based on titanium and aluminum and containing 50-85% titanium, 15-36 % Al, and at least one other element selected from the group consisting of Cr, Nb, V, Mo, Si and Zr, and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

18. The method of Claim 1, wherein the metallic alloy containing at least 50% zirconium and at least one other element selected from the group consisting of Al, V, Mo, Sn,

Si, Ti, Hf, Cu, C, Fe and Mo and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

19. The method of Claim 1, wherein the metallic alloy is nickel aluminide containing at least 50% nickel, 20 - 40% Al and optionally at least one other element selected from the group consisting of V, Si, Zr, Cu, C, Fe and Mo and inevitable impurity elements, wherein the impurity elements are less than 0.05% each and less than 0.15% total.

20. The method of Claim 1, wherein the metallic alloy is a castable aluminum metal matrix composite based on an aluminum alloy which is reinforced with 20 to 60 volume percent of whiskers or particulates of at least one compound selected from the group consisting of silicon carbide, aluminum oxide, titanium carbide and titanium boride.

21. The method of Claim 1, wherein the alloy is melted by a method selected from the group consisting of vacuum induction melting and plasma arc remelting.

22. The method of Claim 1, wherein the mold is cylindrical and rotated at high speeds between 50 to 3000 RPM around its own axis during the casting process.

23. The method of Claim 1, wherein the substrate of the composite mold has been isostatically or vibrationally molded.

24. The method of Claim 1, wherein the graphite of the substrate of the mold has isotropic grains with grain size between 3 and 10 microns, flexural strength between about 7,000 and 20,000 psi, compressive strength between about 12,000 and 35,000 psi, and porosity below about 13 %.

25. The method of Claim 1, wherein the isotropic graphite which constitutes the substrate of the mold has a density between about 1.77 and 1.9 grams/cc and compressive strength between about 17,000 psi and 35,000.

26. The method of Claim 1, wherein the substrate of the mold has been made by machining from isotropic graphite which has been isostatically or vibrationally molded.

27. The method of Claim 1, wherein the coatings of the refractory metal such as W or Re or refractory metal carbide such as TaC or HfC have Vickers Hardness between 2200 and 3500 HV.

28. A mold for making cast shapes of a metallic alloy, comprising a substrate consisting essentially of an isotropic graphite, wherein the substrate has a cavity, wherein the surface of the cavity has been coated with a thin layer of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC

29. The mold of Claim 28, wherein the cavity is a machined cavity and a coating

of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC is deposited on the surface of the machined cavity via a process selected from the group consisting of chemical vapor deposition, plasma assisted chemical vapor deposition, and sputtering.

30. The mold of Claim 28, wherein the thickness of the coating of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC on the surface of the cavity of the mold is from 2 to 500 microns.

31. The mold of Claim 28, wherein the thickness of the coating of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC on the surface of the cavity of the mold is from 7 to 100 microns.

32. The mold of Claim 28, wherein the thickness of the coating of a refractory metal such as W or Re or a refractory metal carbide such as TaC or HfC on the surface of the cavity of the mold is from 10 to 25 microns.

33. The mold of Claim 28, wherein the isotropic graphite of the main body has been isostatically or vibrationally molded and has ultra fine isotropic grains between about 3 and 40 microns, a density between about 1.65 and 1.9 grams/cc, flexural strength between about 5,500 and 20,000 psi, compressive strength between about 12,000 and 35,000 psi, and porosity below about 15%.

34. The mold of Claim 28, wherein the substrate of the composite mold has been isostatically or vibrationally molded.

35. The mold of Claim 28, wherein the graphite of the substrate of the mold has isotropic grains with grain size between about 3 and 10 microns, flexural strength between about 7,000 and 20,000 psi, compressive strength between about 12,000 and 35,000 psi, and porosity below about 13 %.

36. The mold of Claim 28, wherein the isotropic graphite which constitutes the substrate of the mold has a density between about 1.77 and 1.9 grams/cc and compressive strength between about 17,000 and 35,000 psi.

37. The mold of Claim 28, wherein the substrate of the mold has been made by machining from isotropic graphite that has been isostatically or vibrationally molded.